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GET CONTROL OF YOUR PROCESS

READ IT & WIN
AD CONTEST
SEE PAGE 93

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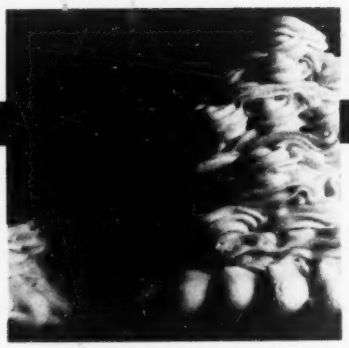
FOOD ENGINEERING



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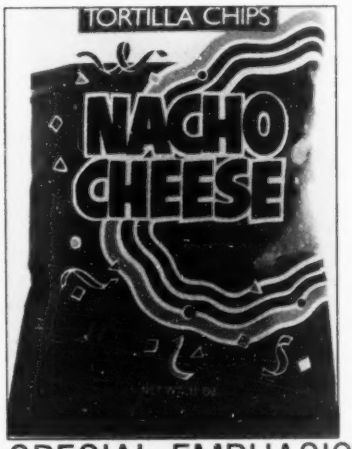

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JESSE H. NEAL AWARD-WINNING PUBLICATION

CHILTON FOOD GROUP

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Agreement on food signed with Soviets

U.S. Department of Commerce Secretary Robert Mosbacher signed an agreement early in June to promote trade between the U.S. and U.S.S.R. in the area of food processing technology.

The agreement creates a team chaired by the Commerce Dept. and the Soviet State Commission on Food and Procurement and includes members of American food processing companies, and representatives from the U.S. and Soviet government. Through the accord, American companies will learn more about the manufacturing needs of Soviet companies and of the possibilities of joint ventures.

A number of hurdles make trade with the Soviets difficult. The ruble has no value outside of the Soviet Union. Telephone lines and computer connections are primitive or nonexistent in some areas. Only large companies have enough capital to gamble in this environment. However, President Mikail Gorbachev has made it clear that the Soviets will only deal with those companies accepting the Soviet challenge now, not in several years.

Vladilen Nikitin, whose position in the Soviet Union is equivalent to our Secretary of Agriculture, signed the accord, saying it was a small step, but that "everything starts with a small step." The agreement concluded a three-day conference sponsored by the Food Processing Machinery & Supplies Association and the National Food Processors Association.

Dairy processors turn conservative

U.S. dairy processors have hedged their bets this year by foreseeing a planned total sales growth of just three to four percent, compared to last year's forecast of five to six percent. However, these figures gathered by the Dairy and Food Industries Supply Association's (DFISA) 1990 Capital Equipment and Supplies Survey were more optimistic than the U.S. Department of Commerce dairy growth rate forecast of 3.3 percent last year. Approximately 24 percent of the 2,138 dairy processors in the U.S. and Canada responded to DFISA's survey.

Top concerns of dairy processors

Dairy processor concerns	Percentage response 1989	1990
Fat substitutes	4	35
Packaging	33	16
Quality	50	60
Fed./state regulations	8	21
Total costs	81	71

Source: DFISA.

Total costs, quality and fat substitutes were top processor concerns for 1990.

This year, 35 percent of the processors said reduced-fat products, fat substitutes, new sweeteners, cholesterol and consumer health issues were top concerns. This represented a break with previous years, when packaging had commanded 33 percent interest in 1989 to only 16 percent this year.

Raw milk supply shortages *and increased costs were top economic worries, followed closely by the nation's economy. This represented a drop of interest in cost margin pressures and rising equipment/product costs, which had drawn the concern of two-thirds of the respondents in 1989. This year, cost margin pressures drew ten percent interest and rising costs, six percent.*

Sixty percent of the respondents felt that greater emphasis must be placed on organoleptical quality (taste and texture), higher standards, increased customer awareness and safer quality in products, up from 50 percent in 1989. As in previous years, processors regard customer service and centralized distribution as important check marks in their equipment buying decisions. Non-DFISA members may purchase the survey for $50 by contacting DFISA at (301) 984-1444.

Sara Lee closes Deerfield plant

Sara Lee Bakery announced plans to close its 26-year old production facility in Deerfield, IL by March 1, 1991. Headquarters, research and development and technical services will remain in the Chicago area. The Deerfield plant currently employs 500 people. In addition to the plant closing, 100 administrative employees will be laid off.

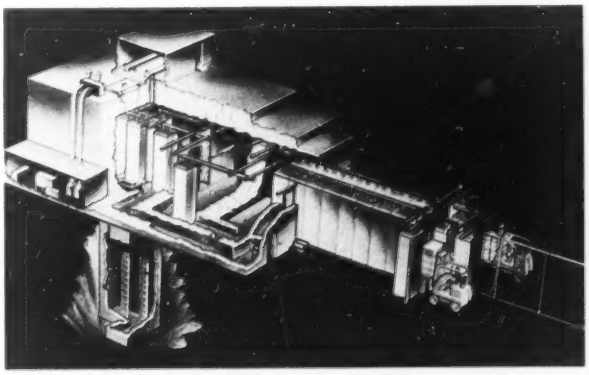
Consumers eye labels with skepticism

Consumers gave food labels low marks for credibility according to an FMI study. (Source: FMI.)

When P.T. Barnum said there's a sucker born every minute, he certainly wasn't referring to today's consumer. In a recent study completed by the Food Marketing Institute (FMI), only eight percent of supermarket shoppers said manufacturer claims were very believable and 53 percent said they were somewhat believable.

When asked the reason for their skepticism, 61 percent said ads don't tell the whole story; 49 percent said **statements are not always truthful;** and 26 percent dismissed statements as being mere gimmicks. "With these questions in their minds, shoppers are looking to the government to make sure claims on food packages are accurate," said Timothy Hammonds, senior vice president of FMI, as he addressed attendees of FMI's annual meeting in Chicago. He reported that eight in ten shoppers are confident in the safety of the food supply, up from six in ten after the Alar and Chilean grape scares.

FDA clears irradiation



Public opposition in the U.S. will probably prevent the use of irradiators, such as this one, that can irradiate pallets of food. (Source: Nordion International Inc., Ontario.)

The Food and Drug Administration (FDA) has approved the use of irradiation to control Salmonella and other illness-causing bacteria in chicken, turkey and other poultry. Although irradiation is a promising technology, public opposition will probably prevent its advantages from ever being realized in the U.S. Although there are no official figures for the outbreaks of foodborne diseases, the FDA estimates that almost **every American suffers a foodborne illness** every year or two. Such episodes can range from a simple stomachache to incapacitating illnesses that occasionally result in death. The FDA also approved of gamma radiation, electron radiation and x-ray treatments of poultry, including mechanically-deboned poultry. For more information on irradiation, see page 84.

Negotiations break down between DFISA & IDFA

Negotiations to form a joint show have broken down between the Dairy and Food Industries Supply Association, Inc. (DFISA) and International Dairy Foods Association (IDFA). DFISA said it denied IDFA's request for half the net revenues from a jointly-sponsored Food & Dairy EXPO. DFISA based its refusal on the basis that close to 60 percent of its membership is comprised of companies whose primary business is food products other than dairy and that the strictly dairy IDFA is not entitled to 50 percent.

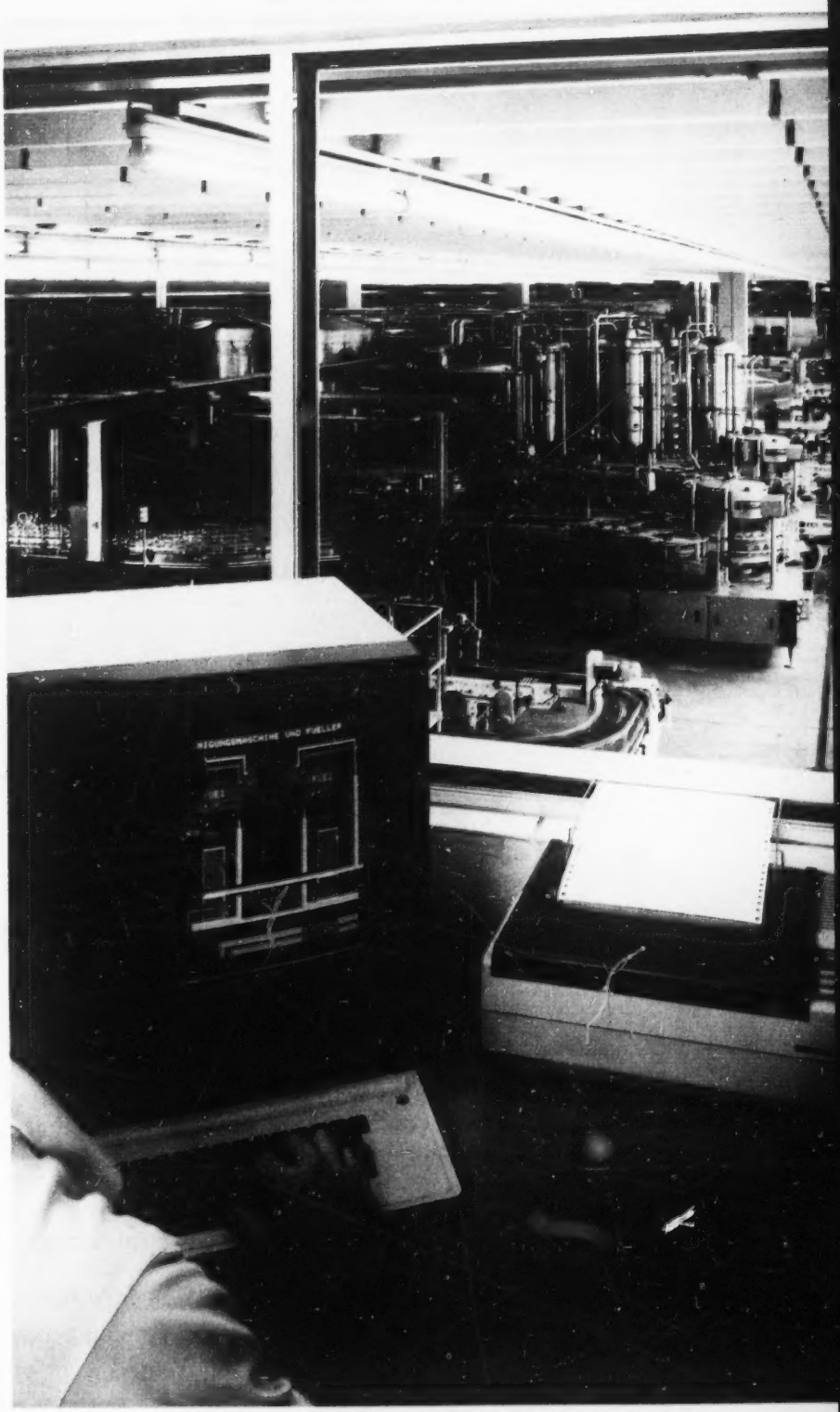
However, DFISA has offered guaranteed funds based on net square feet of exhibit space sold (see April FE, page 15). The IDFA includes the International Ice Cream Association, Milk Industry Foundation, National Cheese Institute and American Butter Institute.

GETTING CONTROL OF YOUR PROCESS

Process control, without a doubt, continues to gain in importance in the food industry. Many talk automation but fewer actually implement it. What is the current state of affairs in process control?

MARGIE J. RUSSELL
TECHNICAL EDITOR

The new flavor on that snack product did well in test markets and quickly went to national distribution. And now, it is doing so well that your plant just got flooded for an immedi-



Control systems continue to show a significant return on investment.

(Source: Siemens Corporation.)

ate 10,000 cases in various sizes on a processing line that was not made to handle such numbers. Projections indicate the orders will continue.

It is time for panic?

No, not yet.

Even though it will be difficult—overtime, strained machines and strained employees, more raw materials—the orders will be filled. But, these and future orders might be completed a little easier with the help of process automation, which allows for expansion and less downtime. Process automation allows for flexibility as well, for who knows when a new flavor will be introduced and supersede the former one?

For many food plants, though, this scenario occurs many times with many different products. Historically, the food industry has always been the most difficult of the process industries to automate, but is this because it has become its own worst enemy?

"When you contrast food to other process industries, food tends to lag behind these other industries five to 10 years," explains Richard D. Dunbar, Market Manager, Food and Consumer Goods, Honeywell Inc., Phoenix, AZ. "There is a tremendous drive now to catch up and take advantage of this new technology."

In general, Dunbar points out, there are two types or classes of food companies using automation: those that have done it successfully (big players like Kraft/General Foods) and smaller companies that are struggling with it. But, these smaller companies often see improvement in quantum

Improving efficiency with GRAFCET

Since its introduction, the programmable controller (PLC) has become the primary device for providing the control necessary to automate industrial processes. You could then infer that if a system is able to run automatically, it must have a definable, repeatable sequence.

With the traditional tools available to program a PLC or a micro-PLC, sequences must be implemented using either ladder diagram programming, boolean statements, or a "higher level" statement language. In any of these languages, creating a sequence can involve extensive interlocking logic, usually with internal control relays or bits. The resulting program can be difficult to create, troubleshoot, or modify.

Introduced by Telemecanique for its PLCs in 1978, GRAFCET is a method of charting a sequential operation. GRAFCET is a very simple representation of steps and transitions which control a sequence of events. A step, represented by a square box, means an action is to be taken: a motor is turned on or a valve is closed. A transition, represented by a short horizontal line, defines those conditions which must be met in order to move from one step to the next.

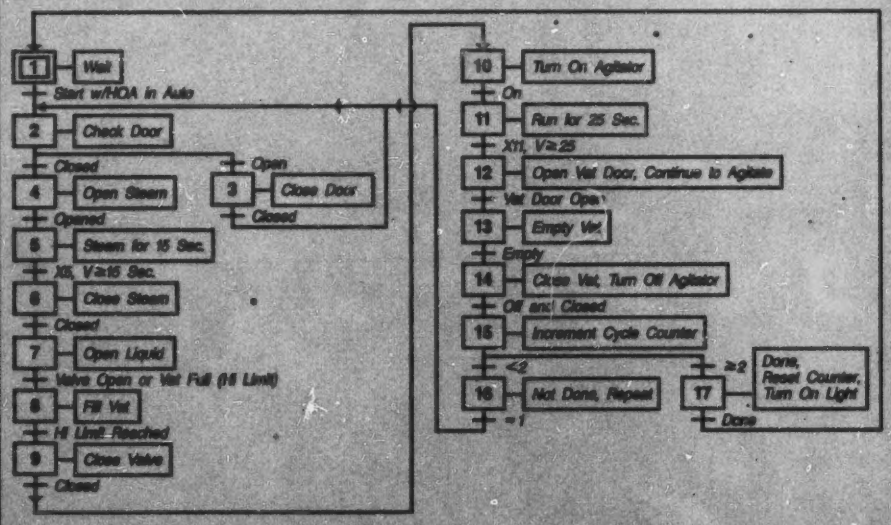
An initial step is represented by a double concentric box. Each GRAFCET chart must have an initial step. A large sequential control operation will have several GRAFCET charts, and each chart has an initial step.

A step in a GRAFCET chart is followed by a transition, followed by another step, another transition, another step and so forth as the sequence progresses. Directed links, shown as horizontal and vertical lines, are used to connect the steps and transitions. These define the sequential relationship of the steps and transitions.

A common operation in the food industry is cleaning mixing vats; the accompanying figure depicts a clean-in-place operation using a GRAFCET chart.

The process starts with the initial step labeled as WAIT. This step is an active step waiting for the start conditions to be sat-

Clean in Place GRAFCET Chart



jumps when the control systems get the kinks out.

Many times, too, the implementation of automation in a facility depends on the types of products that are being produced rather than the size of the company. Those companies producing products in changing market conditions are able to use automation more effectively than those producing institutional-type products such as oils and flours. Companies with market-driven products see the most benefit from automation because they need flexibility. "Flexibility is the key for these flexible-type foods," says Dunbar. "However, stable-type food producers sometimes ignore the benefits of automation. They feel they know where their costs are and don't need it. What they don't understand is that improved control can lower their costs."

Total sales of automation equipment purchased for use in the food industry amounted to about $340 million in 1989, according to Andy Chatha of Automation Research Corporation (ARC), Medfield, MA. Programmable logic controllers (PLCs) alone accounted for almost $100 million of this total and are proving to be the most popular piece of automation equipment for the food industry. Batch-type systems which are only used for batch process control and include personal computers (PCs) and single loop controllers, outsold all categories with $160 million. Distributed control systems (DCSs) netted about $80 million in sales. Leading the way in this category is Fisher

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isfied. The transition from step 1 to step 2 is awaiting the start button and the H-O-A switch to be placed in AUTO.

In step 2, the process waits for the vat door status. If the transition from step 2 to 4 is satisfied, the door is closed. Once the door is closed, the sequence advances to step 4. This is accomplished using ladder logic which references the GRAFCET chart.

GRAFCET does not eliminate ladder logic; it enables ladder logic to be used in its most effective form. GRAFCET defines the sequence and thus the interlocking that would have been done in ladder logic.

Transitions are defined by "zooming" in or windowing into a transition. The logic is then entered in ladder diagram or a "higher level" statement language. In GRAFCET, only an active step and its immediate downstream transitions are scanned.

Within the TSX 7 programmable controller, the logic is divided into three sections called the pre-processing, sequential processing, and post-processing. The sequential processing is where the GRAFCET charts reside. When the CPU scans the logic, it scans the pre-processing first, then the sequential processing and finally the post-processing.

Actions can be defined within the step or in the post-processing; the preferred method is to define them in the post-processing. Each step has a *bit* associated with it. For example, when step 1 is active, bit X1 = 1. Actions can also increment a counter such as is required in step 15 to count cycles. This could be accomplished by having bit X15 increment a counter. The transition from step 15 to step 16 or step 17 tests the counter value.

However, given the way GRAFCET executes, many times the question is raised on how emergency stops are handled. If a PLC only allows the program to be written in GRAFCET with no other provisions, then an exception condition would have to be incorporated into each transition. This would require a lot of redundant programming. Telemecanique solved the problem much easier.

The pre-processing is logic that has an effect on the GRAFCET chart. In an emergency condition, it may be necessary to freeze the GRAFCET chart and disable all outputs. Within the TSX 7 controller there are system bits for performing this function. The logic of when to do it is written into the pre-processing as a simple combinational ladder statement. All of the pre-processing logic is scanned in each scan. As such, the emergency condition will be seen regardless of which step is active in the sequential logic.

In addition, GRAFCET has the ability to combine a large number of different sequences and coordinate them simultaneously. Simultaneous sequences are divided into the simultaneous activation of multiple sequences (divergence) and the simultaneous de-activation of multiple sequences (convergence).

Because of these characteristics, it has become easy to troubleshoot using a GRAFCET chart. Troubleshooting now involves: 1) when the process stops, check which steps are active; and 2) check the transition below each active step. The problem will be in the transition.

Why is this so effective? If a GRAFCET chart stops, it is only because a transition has not been satisfied. Now instead of searching through rungs of ladder logic, the program is self-diagnosing. When downtime can cost thousands of dollars per hour, having a troubleshooting tool like this can easily save the cost of the system.

Donald Helmey, Product Manager, Electronic Dialogue, Telemecanique Inc., Westminster, MD

Type	'89 Dollars		'94 Dollars		AGR*
Batching systems	23.0	14.5%	25.8	11.3%	2.3%
DCSs	39.5	24.9%	56.6	24.8%	7.5%
PLCs	50.2	31.7%	84.4	37.0%	10.9%
PCs	22.7	14.3%	27.3	12.0%	3.8%
Workstations	9.4	5.9%	15.1	6.6%	10.1%
Minicomputers	13.9	8.7%	18.9	8.3%	6.4%
Total	158.6	100.0%	228.1	100.0%	7.5%

Source: Automation Research Corporation. *Annual growth rate

Many small, integrated control systems are available to the industry which perform vital functions such as trending, reporting, and batch management. (Source: Honeywell Inc.)

Controls (Austin, TX) whose systems are primarily purchased for batch applications, followed by Bailey Controls (Wickliffe, OH), holding on to a second place standing for food industry sales in 1989. Capturing an impressive third place was Taylor Systems/ABB Process Automation, Inc. (Rochester, NY) who has been gobbling up a significant part of automation sales in the food industry with its *Taylor MOD 300* system. (See chart.)

When to automate

Many times in the food industry, it is no longer a question of "should we automate." It has become a question of "when can we do it and how are we going to do it."

"Automation is an ongoing process of change," explains James R. Pettigrew, President of Progressive Control Systems, Inc., Milford, OH, "and involves much more than putting a PLC on a machine. You must consider the *process* as well."

Pettigrew, a systems integrator, says the processing area lacks a lot of sophistication and technology. Many times, clients don't understand their process. He explained that smaller manufacturers go with packaging equipment that is automated because the packaging vendors are up with the latest in technology. This probably all started in order to eliminate giveaways on the packaging line and automation was found to be the key in preventing this by accurately maintaining target weights.

Implementing an automation strategy also requires a significant amount of development. It just does not happen overnight. Automation represents an aid and a solution for long term planning; it is not a quick fix. An automation strategy for a manufacturer must consider the needs of system expandability and system flexibility.

"There are still two main keys to putting in an automation project," says Honeywell's Dunbar. "The first is a commitment on the part of the food company to put the necessary resources behind the installation. The second involves the supplier. A company needs a supplier that is capable of providing equipment that is matched to the application."

Another important factor often overlooked when implementing an automation project is that everyone who should be involved in the project is involved. Needless to say, process engineers, systems integrators and the like are involved from the beginning but to get continuous improvement during the project, production personnel should also be included in the team effort since these are the individuals who will be working with the system day in and day out.

In any large undertaking, cost justification is always the final determining factor to the success of the project. Generally, the benefits of process automation outweigh the costs of the equipment and systems. Automation has been found to be particularly pos-

What really constitutes state-of-the-art?

Why does the food industry seem to be lagging behind others in the area of controls? This is a frequently discussed topic among process and control engineers in the food industry. Quite often we attend meetings and seminars where we are exposed to new features and see examples that whet our appetites.

We return from these sessions with enthusiasm trying to find applications in our own operations to implement this new knowledge. Little or nothing happens. Next year, the cycle is repeated. Why? What's wrong?

I am not suggesting that there haven't been some *new* installations which have incorporated sophisticated controls. But how many significant retrofits have you been involved with, or are aware of? Are we being oversold by the controls manufacturers on the incremental benefits of their newer systems? I'd like to offer some thoughts on definitions, industry differences, consumer expectations, and hardware.

First, we need to differentiate between management information systems (MIS) that provide data on inventory, uptime, etc. and process control systems (PCS) focusing on temperature, pH, etc. Much hoopla about new control systems are, in fact, MIS not PCS.

Secondly, while some vendors would like us to believe that their successful implementations in other industries have a parallel for us, I find reality to be off in a side alley.

Similarities can be deceiving. Many foodstuffs are pumped through piping systems that might be mistaken for a petrochemical plant. And yes, a few formulated products, for example, frozen pizza, multi-component frozen entrees, move along an assembly line like a car. So what's the problem with us automating like them?

Since we are food processors, the problem is that we are selling TASTE, one of the most difficult attributes to measure. We therefore rely on many inferential measurements and taste panels. But I don't know how to put a taste panel's opinions into a controller.

We take recalls of our automobiles for granted. We return our cars to the dealer, have the repairs performed and then later, we often buy another model from that same manufacturer when the time comes to replace it. But recalling a food product is a different story. Several companies no longer exist as the result of a process control malfunction or monitoring oversight. We are expected to provide a much greater confidence level for the consumer and regulatory agencies.

Finally, without question, there already is plenty of technology in controllers. But controllers require two inputs, the setpoint and the measured signal, and sensors are still the weakest link in our efforts to further advance control systems in the food industry. Temperature and pH sensors are generally adequate; viscosity and moisture sensors somewhat trickier depending on the product; and in-line flavor and texture sensors virtually unavailable. We still need our master chefs and brewmasters in many applications.

Undoubtedly, we need more and better tools and techniques to turn much of our art into science. Therefore, if we agree on our definitions and acknowledge the consumer's higher expectations (and less forgiveness) in terms of trust, we need to put more pressure on the instrument suppliers to develop sensors that will give us the measurements we need for the control hardware that already exists. Much has been done, but much more remains to be done.

Stay tuned for more from Steven Chall, a process engineering specialist with CHALLengrs, a Minneapolis firm providing consulting and contract engineering services to the food industry. Starting in our August issue, Mr. Chall will become a regular columnist in FE's Processing and Control section. —Ed.

itive for the long term in a processor's strategy plan.

Interestingly enough, it is not just economics that is preventing further expansion of automation in the food industry. There is still a lot of resistance to new technology and any project team must get upper management to fully sponsor and back an automation project. And, there is another factor: fear. Jim Pettigrew says there is often a fear for change of technology and a fear for people's jobs. Some of the other fears listed by Pettigrew include: fear that only an engineer can run the line and control system after it is installed, operators cannot run the system in manual, and "comfortability" in a plant operation is lost during installation and replaced with an "out of control" feeling.

But, in spite of economics, difficult processes and fear, are we making any headway in automating the food industry? "Most definitely," says Rich Dunbar. "Processors have more market opportunities now and must take automation principles into consideration when they develop their long term strategies. They will need to exploit automation technologies in order to build and maintain their competitive advantage." ▲